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REPORT FOR CONSULTATION ON THE MINNEAPOLIS-ST. PAUL AIR QUALITY CONTROL REGION

National Air Poilution Control Administration
Washington, D.C.

April 1969

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REPORT FOR CONSULTATION ON THE

MINNEAPOLIS-ST. PAUL

AIR QUALITY CONTROL REGION

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Consumer Protection and Environmental Health Service
National Air Pollution Control Administration

April 1969

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PREFACE

The Secretary, Department of Health, Education, and Welfare, is directed by the Air Quality Act of 1967 to designate "air quality control regions" to provide a basis for the adoption and enforcement of regional air quality standards. In addition to listing the major factors to be considered in the development of region boundaries, the Act stipulates that the designation of a region shall be preceded by consultation with appropriate State and local authorities.

The National Air Pollution Control Administration, DHEW, has conducted a study of the Minneapolis-St. Paul Metropolitan Area, the results of which are presented in this report. The Region* boundaries proposed in this report reflect consideration of all available and pertinent data; however, the boundaries remain subject to revisions suggested during consultation with State and local authorities. Formal designation of a Region will follow the consultation meeting. This report is intended to serve as background material for the consultation.

The Administration appreciates assistance received either directly during the course of this study or indirectly during previous activities in the Minneapolis-St. Paul Metropolitan Area from official air pollution control agencies at the State and local level, and the Metropolitan Council.

*For the purposes of this report, the word region, when capitalized, will refer to the Minneapolis-St. Paul Air Quality Control Region. When not capitalized, unless otherwise noted, it will refer to air quality control regions in general.

INTRODUCTION

> "For the purpose of establishing ambient air quality standards pursuant to section 108, and for administrative and other purposes, the Secretary, after consultation with appropriate State and local authorities shall, to the extent feasible, within 18 months after the date of enactment of the Air Quality Act of 1967 designate air quality control regions based on jurisdictional boundaries, urban-industrial concentrations, and other factors including atmospheric areas necessary to provide adequate implementation of air quality standards. The Secretary may from time to time thereafter, as he determines necessary to protect the public health and welfare and after consultation with appropriate State and local authorities, revise the designation of such regions and designate additional air quality control regions. The Secretary shall immediately notify the Governor or Governors of the affected State or States of such designation."
>
> Section 107(a)(2), Air Quality Act of 1967

THE AIR QUALITY ACT

Air pollution in most of the Nation's urban areas is a regional problem. This regional problem demands a regional solution, consisting of coordinated planning, data gathering, standard setting, and enforcement. Yet, with few exceptions, such coordinated efforts are notably absent among the Nation's urban complexes.

Beginning with the Section quoted above, in which the Secretary is required to designate air quality control regions, the Air Quality Act presents an approach to air pollution control involving coordinated efforts by Federal, State, and local governments, as shown in Figure 1. After the Secretary has (1) designated regions, (2) published air quality criteria, and (3) published corresponding documents on control technology and associated costs, the Governor(s) of the State(s) must file with the Secretary within 90 days a letter of intent, indicating that the State(s) will adopt within 180 days ambient air quality standards for the pollutants

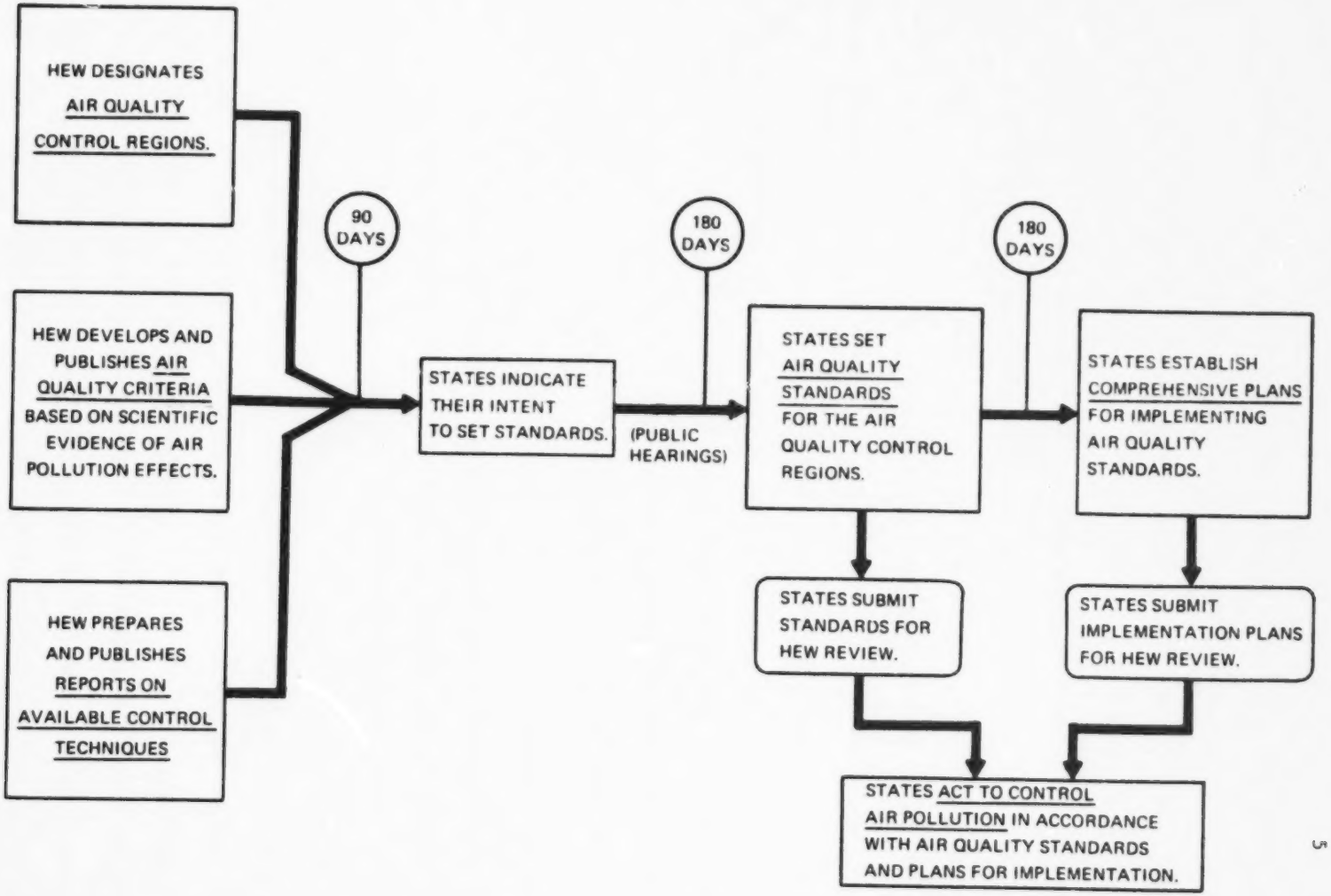
HEW DESIGNATES AIR QUALITY CONTROL REGIONS.
HEW DEVELOPS AND PUBLISHES AIR QUALITY CRITERIA BASED ON SCIENTIFIC EVIDENCE OF AIR POLLUTION EFFECTS.
HEW PREPARES AND PUBLISHES REPORTS ON AVAILABLE CONTROL TECHNIQUES
90 DAYS
STATES INDICATE THEIR INTENT TO SET STANDARDS.
180 DAYS
(PUBLIC HEARINGS)
STATES SET AIR QUALITY STANDARDS FOR THE AIR QUALITY CONTROL REGIONS.
180 DAYS
STATES ESTABLISH COMPREHENSIVE PLANS FOR IMPLEMENTING AIR QUALITY STANDARDS.
STATES SUBMIT STANDARDS FOR HEW REVIEW.
STATES SUBMIT IMPLEMENTATION PLANS FOR HEW REVIEW.
STATES ACT TO CONTROL AIR POLLUTION IN ACCORDANCE WITH AIR QUALITY STANDARDS AND PLANS FOR IMPLEMENTATION.

Figure 1 FLOW DIAGRAM FOR ACTION TO CONTROL AIR POLLUTION ON A REGIONAL BASIS, UNDER THE AIR QUALITY ACT.

covered by the published criteria and control technology documents and adopt within an additional 180 days plans for the implementation, maintenance, and enforcement of those standards in the designated air quality control regions.

The new Federal legislation provides for a regional attack on air pollution and, at the same time, allows latitude in the form which regional efforts may take. While the Secretary retains approval authority, the State(s) involved in a designated region assumes the responsibility for developing standards and an implementation plan which includes administrative procedures for abatement and control. Informal cooperative arrangements with proper safeguards may be adequate in some regions, whereas in others, more formal arrangements, such as interstate compacts, may be selected. The objective in each instance will be to provide effective mechanisms for control on a regional basis.

THE SIZE OF A REGION

Several objectives are important in determining how large an air quality control region should be. Basically, these objectives can be divided into three separate categories. First a region should be self-contained with respect to air pollution sources and receptors. In other words, a region should include most of the important sources in the area as well as most of the people and property affected by those sources. In this way, all the major elements of the regional problem will lie within one unified administrative jurisdiction. Unfortunately, since air pollutants can travel long distances, it is impractical if not impossible to delineate regions which are completely self-contained. The air over a region will

usually have at least trace amounts of pollutants from external sources. During episodic conditions, such contributions from external sources may even reach significant levels. Conversely, air pollution generated within a region and transported out of it can affect external receptors to some degree. It would be impractical and inefficient to make all air quality control regions large enough to encompass these low-level trace effects. The geographic extent of trace effects overestimates the true problem area which should be the focus of air pollution control efforts. Thus, the first objective, that a region be self-contained, becomes a question of relative magnitude and frequency. The dividing line between "important influence" and "trace effect" will be a matter of judgment. The judgment should be based on estimates of the impact a source has upon a region, and the level of pollution to which receptors are subjected. In this respect, annual and seasonal data on pollutant emissions and ambient air concentrations are a better measure of relative influence than short term data on episodic conditions.

The second general objective requires that region boundaries be designed to meet not only present conditions but also future conditions. In other words, the region should include areas where industrial and residential expansion are likely to create air pollution problems in the foreseeable future. This objective requires careful consideration of existing metropolitan development plans, expected population growth, and projected industrial expansion. Such considerations should result in the designation of regions which will contain the sources and receptors of regional air pollution for a number of years to come. Of course, region boundaries need not be permanently fixed, once designated. Boundaries

should be reviewed periodically and altered when changing conditions warrent readjustment.

The third objective is that region boundaries should be compatible with and even foster unified and cooperative governmental administration of the air resource throughout the region. Air pollution is a regional problem which often extends across several municipal, county, and even state boundaries. Clearly, the collaboration of several governmental jurisdictions is prerequisite to the solution of the problem. Therefore, the region should be delineated in a way which encourages regional cooperation among the various governmental bodies involved in air pollution control. In this regard, the existing pattern of governmental cooperation on the whole range of urban problems may become an important consideration. Certainly the pattern of cooperation among existing air pollution control programs is a relevant factor. In general, administrative considerations dictate that governmental jurisdictions should not be divided. Although it would be impractical to preserve State jurisdictions undivided, usually it is possible to preserve the unity of county governments by including or excluding them in their entirety. Occasionally, even this would be impractical due to a county's large size, wide variation in level of development, or striking topographical features.

To the extent that any two of the above three objectives lead to incompatible conclusions concerning region boundaries, the region must represent a reasonable compromise. A region should represent the best way of satisfying the three objectives simultaneously.

PROCEDURE FOR DESIGNATION OF REGIONS

Figure 2 illustrates the procedures used by the National Air Pollution Control Administration for designating air quality control regions.

A preliminary delineation of the region is developed by bringing together two essentially separate studies--the "Evaluation of Engineering Factors," and the "Evaluation of Urban Factors."

The study of "Engineering Factors" indicates the location of pollution sources and the geographic extent of serious pollutant concentrations in the ambient air. Pollution sources are located by taking an inventory of emissions from automobiles, industrial activities, space heating, waste disposal, and other pollution generators. Pollution concentrations in the ambient air are estimated from both air quality sampling data and a theoretical diffusion model. When it exists, air quality sampling data is more reliable than the theoretical diffusion model results since the data is directly recorded by pollution measuring instruments. Unfortunately, in many cases air quality sampling data is available for only one or two pollutants measured at an insufficient number of locations. The theoretical model is used to supplement inadequate air quality sampling data. As a whole, the engineering study indicates how large the air quality control region must be in order to encompass most pollution sources and most people and property affected by those sources.

The study of "Urban Factors" encompasses non-engineering considerations. It reviews existing governmental jurisdictions, current air pollution control programs, present concentrations of population and industry,

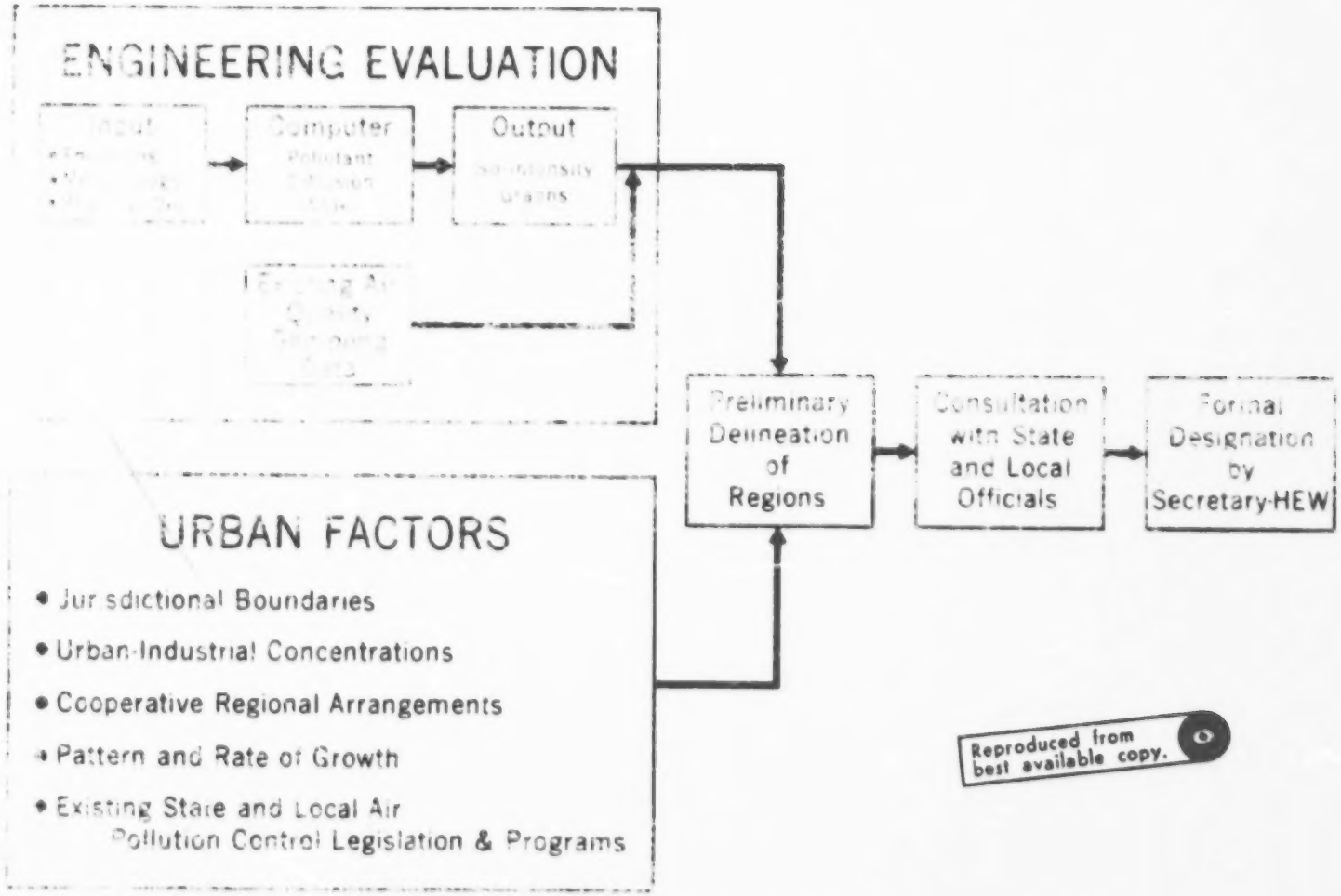

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Figure 2. Flow diagram for the designation of air quality control regions.

and expected patterns of urban growth. Other non-engineering factors are discussed when they are relevant. As a whole, the study of urban factors indicates how large an air quality control region must be in order to encompass expected growth of the pollution problem in the future. It also considers which group of governmental jurisdictions will most effectively administer a strong regional air quality control program.

The conclusions of the engineering study are combined with the results of the urban factors study to form the basis of an initial proposal for an air quality control region. As shown in Figure 2, the proposal is then submitted for consultation with State and local officials. After reviewing the suggestions raised during the consultation, the Secretary formally designates the region with a notice in the Federal Register and notifies the governors of the States affected by the designation.

The body of this report contains a proposal for the boundaries of the Minneapolis-St. Paul Air Quality Control Region and supporting studies on engineering and urban factors. The report itself is intended to serve as the background document for the formal consultation with appropriate State and local authorities.

EVALUATION OF URBAN FACTORS

INTRODUCTION

A number of urban factors are relevant to the problem of defining air quality control region boundaries. First, the location of population is an important consideration, since human activity is the ultimate cause of air pollution, and humans are the ultimate victims. The population growth pattern is another important consideration, since an air quality control region should be designed not only for the present but also for the future. The location of industrial activity and the industrial growth pattern are relevant considerations for similar reasons. Political and jurisdictional considerations are important, since the 1967 Air Quality Act envisions regional air pollution programs based on cooperative efforts among many political jurisdictions. The following discussion of urban factors will present these considerations as they apply to the Minneapolis-St. Paul area.

Population

Figure 3 displays present population densities in the Minneapolis-St. Paul metropolitan area.(1) The counties in the area can be divided into three groups according to population density. The group with the highest population densities (well over 1,000 residents per square mile) contains Ramsey and Hennepin Counties. The group with moderate population densities (about 200 to 300 residents per square mile) contains Anoka,

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(1) Based on the 1968 edition of the Rand McNally Commercial Atlas and Marketing Guide.

Figure 3:

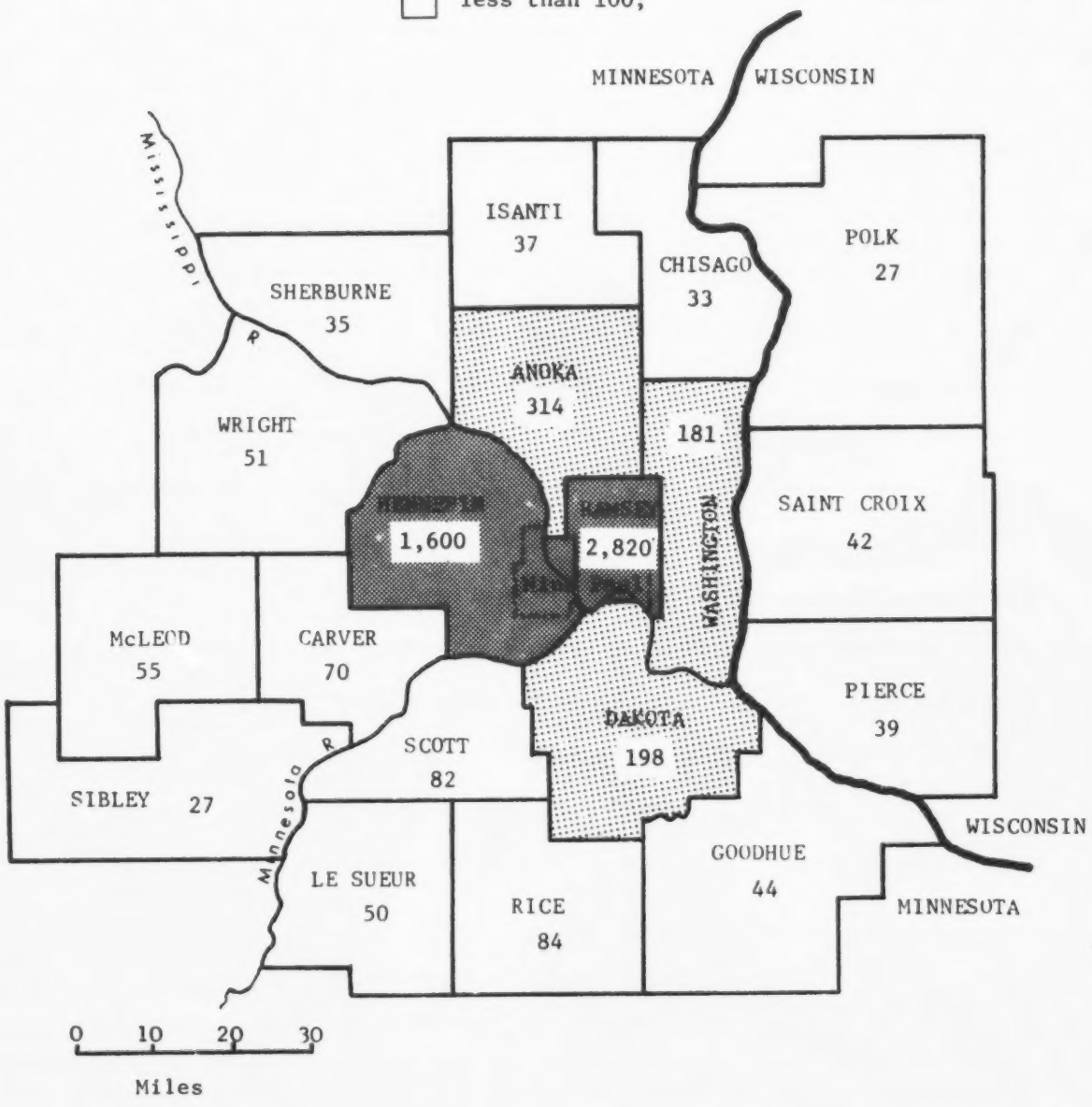
1968 POPULATION DENSITY

Residents Per Square Mile

more than 1,000;

100 to 1,000;

less than 100;



Washington, and Dakota Counties. These counties border the heavily populated urban center on the north, east, and south. The group of counties with low population densities (less than 100 residents per square mile) contains all of the surrounding counties in Minnesota and Wisconsin. Within this group, the most densely populated counties are Rice, Carver, and Scott, which border the urban area on the west and south.

Two sets of population projections to 1985 are available for counties in the Minneapolis-St. Paul area. One set was issued by the Joint Program during October of 1967,(2) and covers seven counties; Ramsey, Hennepin, Anoka, Washington, Dakota, Scott, and Carver. The other set was issued by the Minnesota State Department of Health during December of 1968,(3) and covers all of the counties in the State. In general, the population projections issued by the Joint Program are larger than those of the State Health Department. Specifically the projected growth rates differ by as much as a factor of two for some counties. Table 1 lists present population densities by county and both sets of projected absolute population growth from 1968 to 1985. These figures indicate that during the next 16 years Ramsey and Hennepin Counties are expected to experience the largest amount of population

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(2) Information Bulletin number 11, The Joint Program, an Interagency Land Use-Transportation Planning Program for the Twin-Cities Metropolitan Area, October, 1967.

(3) Minnesota Population Data Book, Vital Statistics Division, Minnesota State Department of Health, December, 1968.

Table 1

POPULATION DENSITIES AND PROJECTED GROWTH BY COUNTY

COUNTY	POPULATION DENSITY, 1968; Residents Per Square Mile:	POPULATION GROWTH, 1968-1985; Additional Residents Per Square Mile:	
		State Health Department Projections:	Joint Program Projections:
Anoka	314	188	235
Carver	70	44	83
Chisago	33	2	--
Dakota	198	225	289
Goodhue	44	-3	--
Hennepin	1,600	514	719
Isanti	37	6	--
Le Sueur	50	0	--
Mcleod	55	6	--
Pierce	39	--	--
Polk	27	--	--
Ramsey	2,820	657	1,309
Rice	84	6	--
Saint Croix	42	--	--
Scott	82	73	62
Sherburne	35	9	--
Sibley	27	-3	--
Washington	181	166	334
Wright	51	5	--

Figure 4:

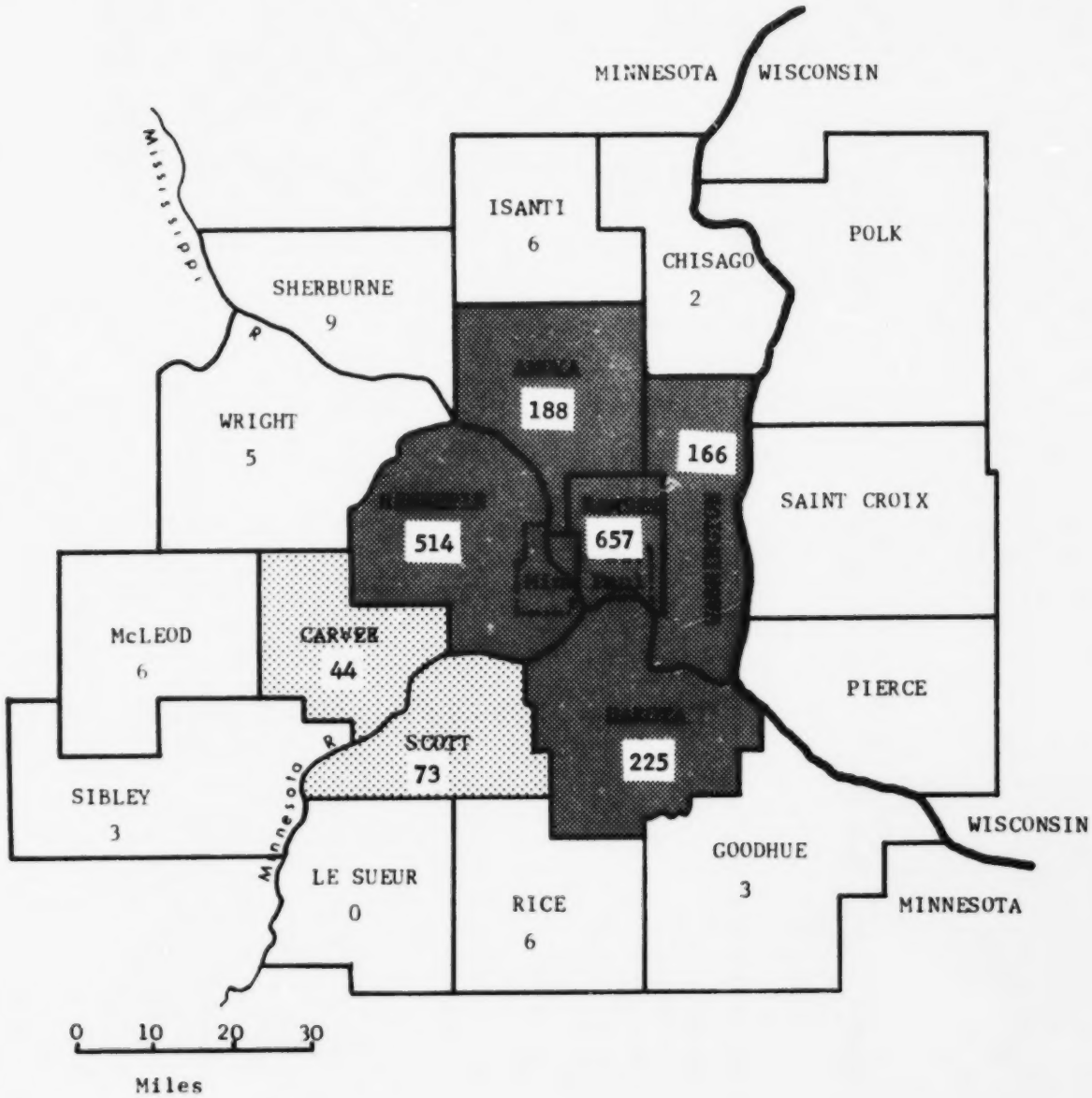
POPULATION GROWTH, 1968-1985

Additional Residents Per Square Mile;

more than 100;

10 to 100;

less than 10;



growth, followed by Dakota, Washington, Anoka, Scott, and Carver. Relative to these seven counties, surrounding counties are expected to experience almost no growth, as demonstrated by Figure 4, which is based upon the projections of the State Health Department. This conclusion would become even stronger if the Joint Program projections were substituted for the Health Department projections in the seven counties.

In sum, on the basis of population estimates and projections, Hennepin and Ramsey constitute the core of the metropolitan area. Anoka, Washington, and Dakota contain major suburbs and satellite cities at the present time. In fact, these five counties now form the Minneapolis-St. Paul Standard Metropolitan Statistical Area. During the next sixteen years, population growth is likely to extend into Carver and Scott counties, thereby increasing the interdependence between these two counties and the core area. The counties outside of these seven are likely to remain rural in nature and generally independent of the core area for at least two decades.

Industry

One method for determining the location of manufacturing activity is based on the number of people employed in manufacturing firms. As shown in Figure 5, which is based on 1963 census data, Ramsey and Hennepin Counties have by far the highest densities of people employed in manufacturing firms. Manufacturing employment is relatively low in surrounding counties. A second method for determining the location

Figure 5:

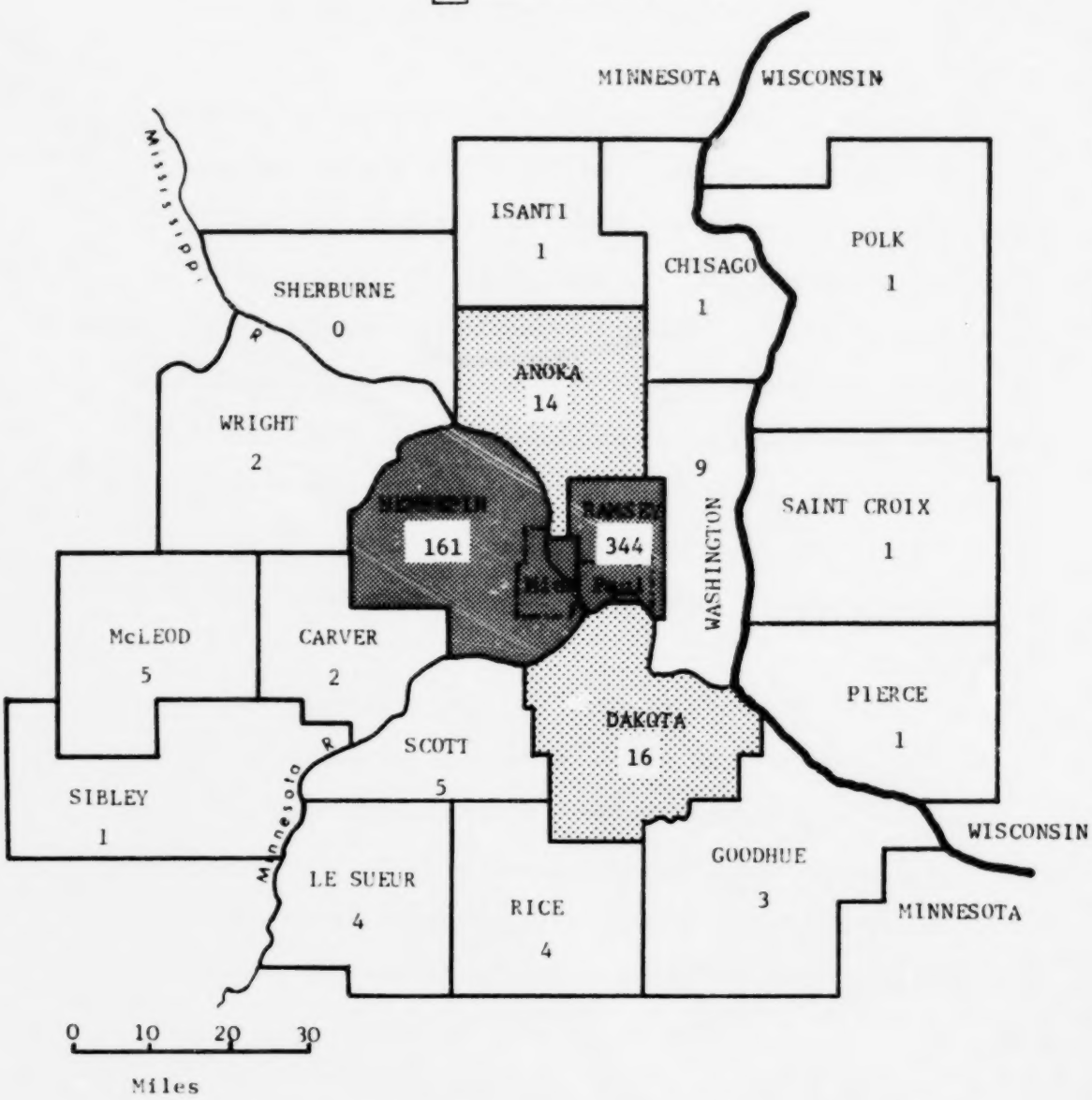
MANUFACTURING EMPLOYMENT DENSITY, 1963

Employees Per Square Mile

more than 100;

10 to 100;

less than 10;



of manufacturing activity can be based on a map of industrial land use. The land use map issued by the Metropolitan Council in January 1968, supports the conclusions of Figure 5; most of the industrial activity in the Metropolitan area is located in Ramsey and Hennepin Counties.

Existing Air Pollution Control Programs

The air pollution control program of the State of Minnesota was established in 1967, as part of the Minnesota Pollution Control Agency. The Agency has authority to adopt regional air quality and emission standards. At the present time, the State program has a budget of about 200 thousand dollars. During 1968, statewide air quality standards were proposed, dealing with sulfur oxides, hydrogen sulfide, oxidants, dustfall, suspended particulates, and soiling index. In addition, emission standards were proposed with special provisions for the Minneapolis-St. Paul metropolitan area, which was defined to include seven counties; Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, and Washington. During December, 1968, public hearings were conducted on the proposed standards for air quality and emissions. The Agency is expected to take final action on some or all of the proposals during 1969.

At the present time, Minnesota law authorizes air pollution control programs operated by county governments and certain classes of municipalities. St. Paul has established a program which is operating on a budget of about 80 thousand dollars. Minneapolis also has a program which is operating at approximately the same budget level. Both programs collect air quality

data and enforce emission restrictions on smoke and particulate matter. The community of St. Louis Park has adopted a number of regulations, but has not yet developed a budgeted air pollution control program. Although St. Paul and Minneapolis have not entered into any formal agreement for joint activities in the air pollution control field, they have benefited from extensive informal contact and cooperation with each other.

Regional Planning in the Minneapolis-St. Paul Area

The Metropolitan Council is responsible for regional planning and other regional activities within the seven counties of its jurisdiction (Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, and Washington). The Minnesota Legislature created the Metropolitan Council in 1967 by transferring to the Council the staff and responsibilities of the ten year old Twin Cities Metropolitan Planning Commission and by giving significant new powers to the Council. The Council consists of 15 members, all appointed by the Governor for staggered terms. Among the responsibilities which the Legislature requested the Council to undertake were research and study of air pollution control, solid waste disposal, and water pollution control. During the last two years the Council completed a proposal for a solid waste disposal system, for the development of open space in the metropolitan area, and for a metropolitan sewerage system. The Council has also begun work on comprehensive health planning for the area, and a major ecological study to determine where various kinds of development can occur without damaging land resources

and the ecology of the area. The proposed 1969 budget for the Council is about 1.6 million dollars.

SUMMARY

The evaluation of urban factors indicates that an air quality control region composed of the seven counties which are members of the Metropolitan Council (Anoka, Carver, Hennepin, Ramsey, Washington, Scott, Dakota) would satisfy the objectives outlined above for region boundaries. Population densities and industrial concentrations are significant in all of these counties except Carver and Scott at the present time. Carver and Scott are expected to experience rapid development during the next ten to twenty years. Their proximity to the urban center insures increasing interdependence in the future. The seven county area has been considered a cohesive unit by the Minnesota Legislature (when it created the Metropolitan Council in 1967) and by the Minnesota Pollution Control Agency (when it proposed special emission standards for the metropolitan area in 1968). The many activities of the Metropolitan Council, only a few of which were mentioned above, have further developed the unity of the seven county jurisdiction.

EVALUATION OF ENGINEERING FACTORS

INTRODUCTION

The engineering evaluation for the Minneapolis-St. Paul area was based on a study of topography, pollutant emissions, estimated air quality levels and available ambient air quality data. The emission inventory indicated the location of point and area sources, the quantity of pollutants emitted from these sources, and the resulting emission densities. This information was combined with meteorological data and used in a diffusion model to estimate air quality levels in the Minneapolis-St. Paul area. The estimated air quality information was supplemented by measured air quality data whenever available.

TOPOGRAPHY

Minneapolis and St. Paul are located at the confluence of the Minnesota and Mississippi Rivers. The river basins lie about 200 feet below the surrounding terrain, which is generally level except for a few hilly areas to the south and the east of the urban center. Many lakes are scattered throughout the area.

METEOROLOGY

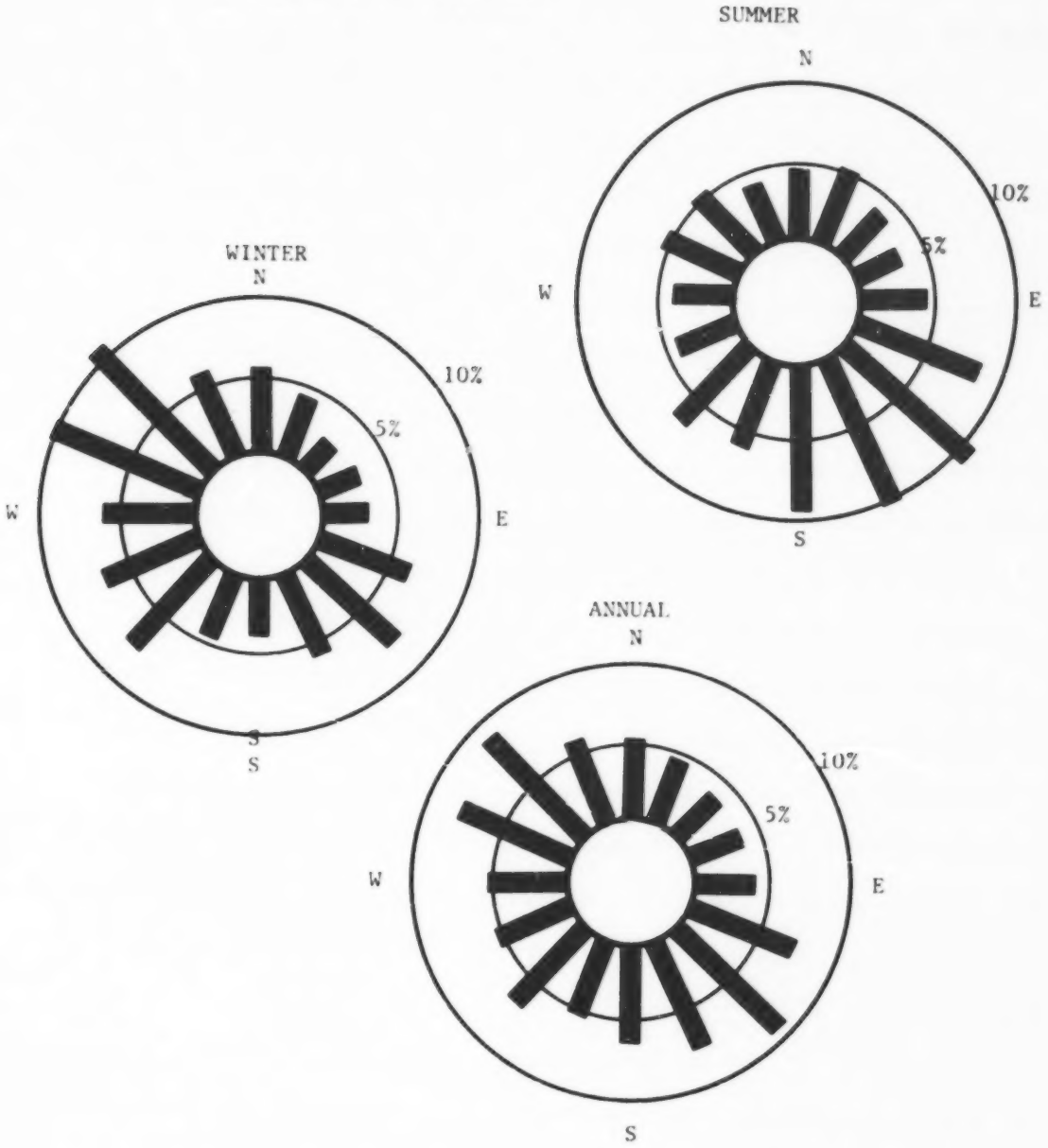
The climate is predominantly continental, with large variations in temperature and rainfall occurring during the course of a year. Changeable weather is the norm.

The Minneapolis wind rose, shown in figure 6, indicates that on an annual basis, winds from the northwest and from the southeast are somewhat more frequent than from other quadrants. The average wind speed

Figure 6:

MINNEAPOLIS WIND ROSE

Frequency of Occurrence



at the surface is nearly 10 miles per hour. In general, the climate favors the dispersion of pollution.

EMISSIONS INVENTORY

The National Air Pollution Control Administration conducted an inventory of air pollutant emissions for the Minneapolis-St. Paul area. Three major pollutants--sulfur oxides, carbon monoxide, and particulates --were considered since they provide a general measure of the extent of the air pollution problem around the Twin Cities area.

The emissions inventory encompasses seven counties, Anoka, Dakota, Hennepin, Ramsey, Carver, Washington, and Scott. This area was divided into the grid coordinate system shown in figure 7. The estimated emissions of each of the three pollutants were expressed by grid zone as average daily emissions for three different time periods--annual, winter, and summer. Table 2 shows the annual-average daily emissions.

Annual average emission densities for each of the three pollutants in tons per square mile per day were determined by relating the total quantity of pollutants emitted in each of the gri zones to the land area of each zone. Figures 8, 9, and 10 show the resulting densities on maps. Where point sources are responsible for more than 50% of the emissions in a grid zone, this fact is indicated in both Table 2 and the figures.

In general, all of the emission maps indicate high emission rates in the central urban area. The rates become moderate in the suburban areas of Hennepin and Anoka Counties, and decline to low levels in outlying areas in Scott and Carver Counties. The major source of sulfur oxides in

Table 2

TOTAL EMISSIONS BY GRID

Tons Per Day

Grid Number	Sulfur Oxides	Particulates	Carbon Monoxide
1	.33	.17	12.17
2	.35	.21	18.14
3	.25	.18	6.18
4	.06	.01	.03
5	.98	.46	36.54
6	4.03	1.48	68.29
7	1.14	.69	35.14
8	.48	.22	11.76
9	.29	.11	5.51
10	.57	.27	18.30
11	1.81	.80	36.96
12	11.96	5.28	214.07
13	168.93*	27.14*	274.95
14	2.44	1.7	144.16
15	191.78*	3.02*	6.30
16	.24	.18	2.24
17	.98	.42	20.66
18	8.72	2.73	41.00
19	20.88	8.17	318.28
20	40.07	26.35	587.83
21	126.86*	40.44*	164.32
22	.82	.29	11.06
23	.40	.18	6.47
24	.51	.21	6.64
25	2.83*	3.49*	18.66
26	5.72	2.60	51.36
27	218.02*	8.78*	92.60
28	55.02*	10.61*	379.03*
29	.91	.44	14.73
30	.04	.00	.04
31	.37	.15	6.16
32	.39	.20	11.62
33	.34	.16	4.19
34	.47	.22	14.59
35	.45	.18	10.95

36	.33	.16	10.92
37	.00	.00	.00
38	.11	.06	3.83
39	.09	.04	.17
40	.09	.03	.09
41	.36	.14	7.30
42	.28	.11	7.27
43	.09	.05	3.61

*Indicates that more than 50% of the emissions in the grid are due to point sources.

Figure 7:

EMISSIONS INVENTORY GRID SYSTEM

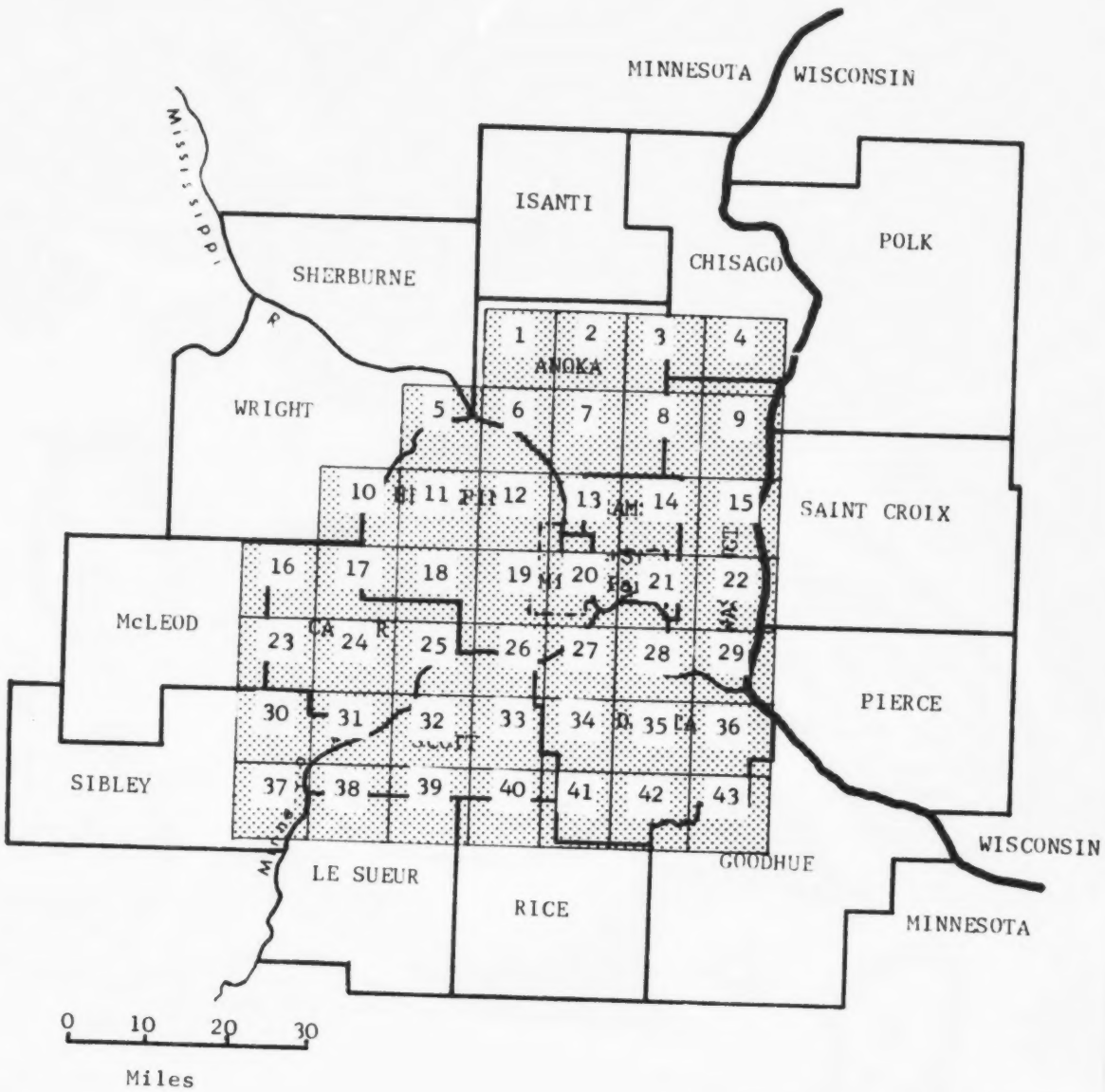


Figure 8:

SULFUR OXIDES EMISSION DENSITY

Tons Per Square Mile Per Day

- more than 1.0;
- 0.4 to 1.0;
- 0.1 to 0.4;
- less than 0.1;

* indicates that more than 50% of the emissions in the grid are due to point sources

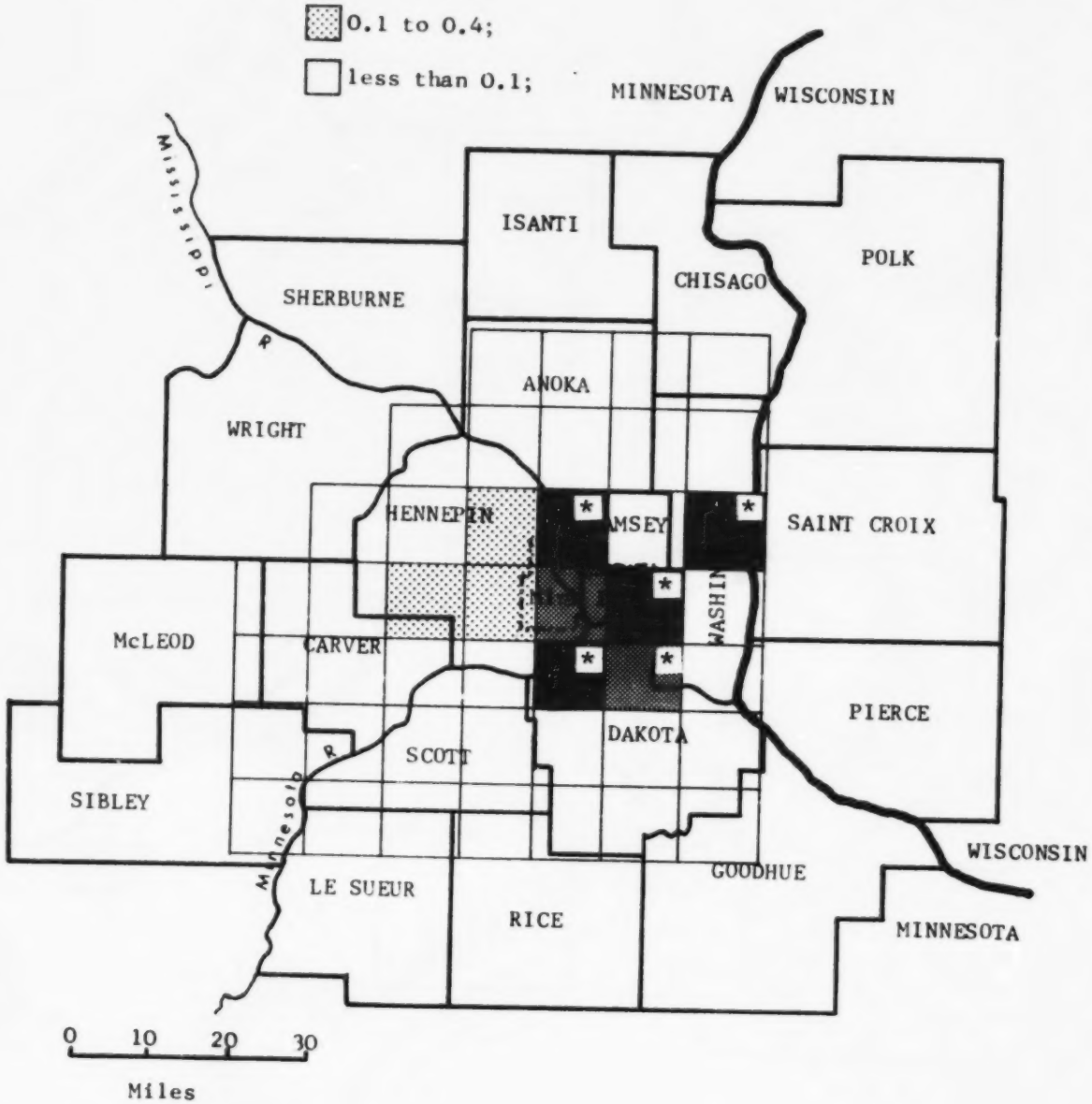


Figure 9:

PARTICULATE EMISSION DENSITY

Tons Per Square Mile Per Day

- more than 0.18;
- 0.06 to 0.18;
- 0.02 to 0.06;
- less than 0.02;

* indicates that more than 50% of the emissions in the grid are due to point sources;

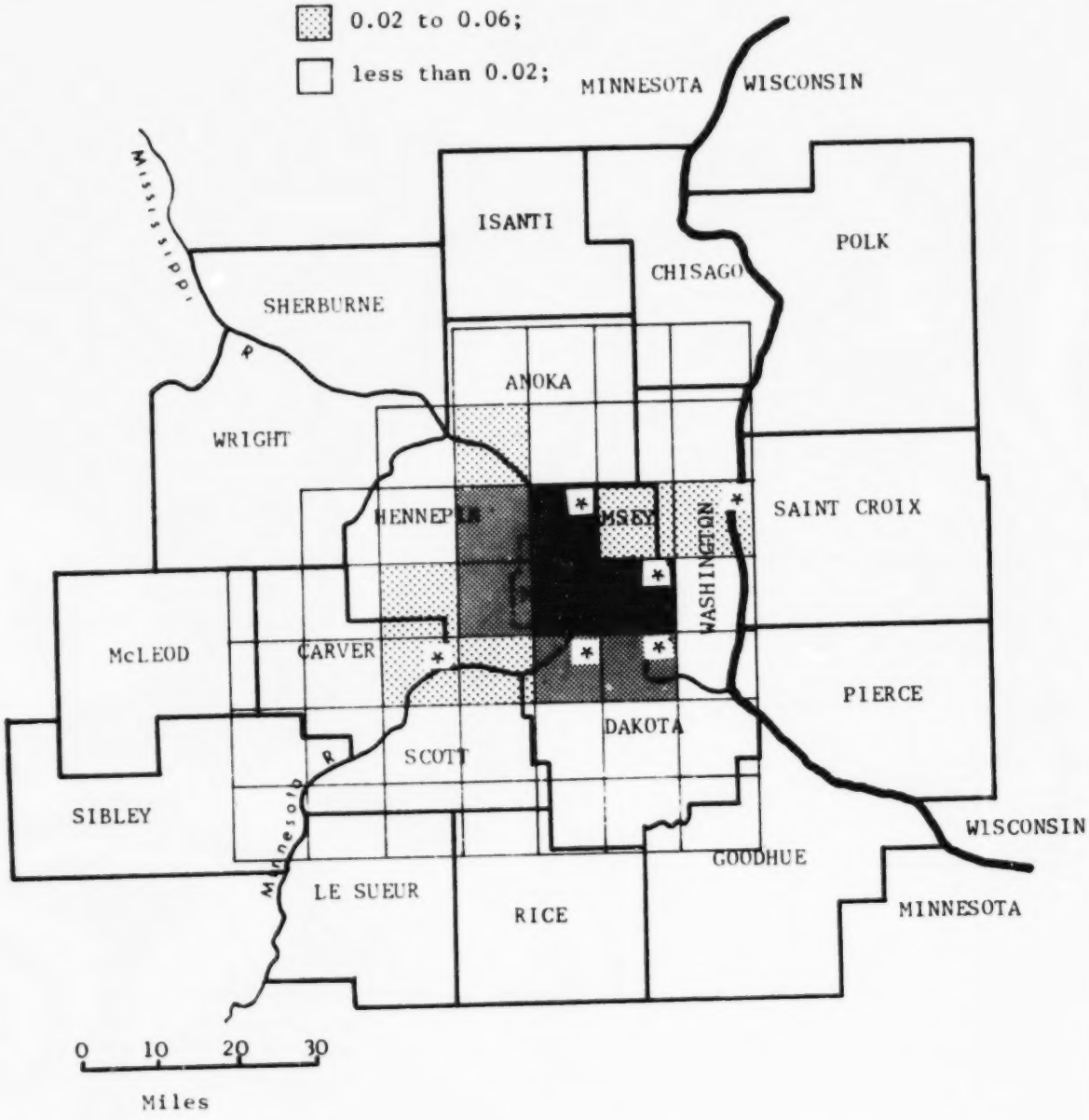


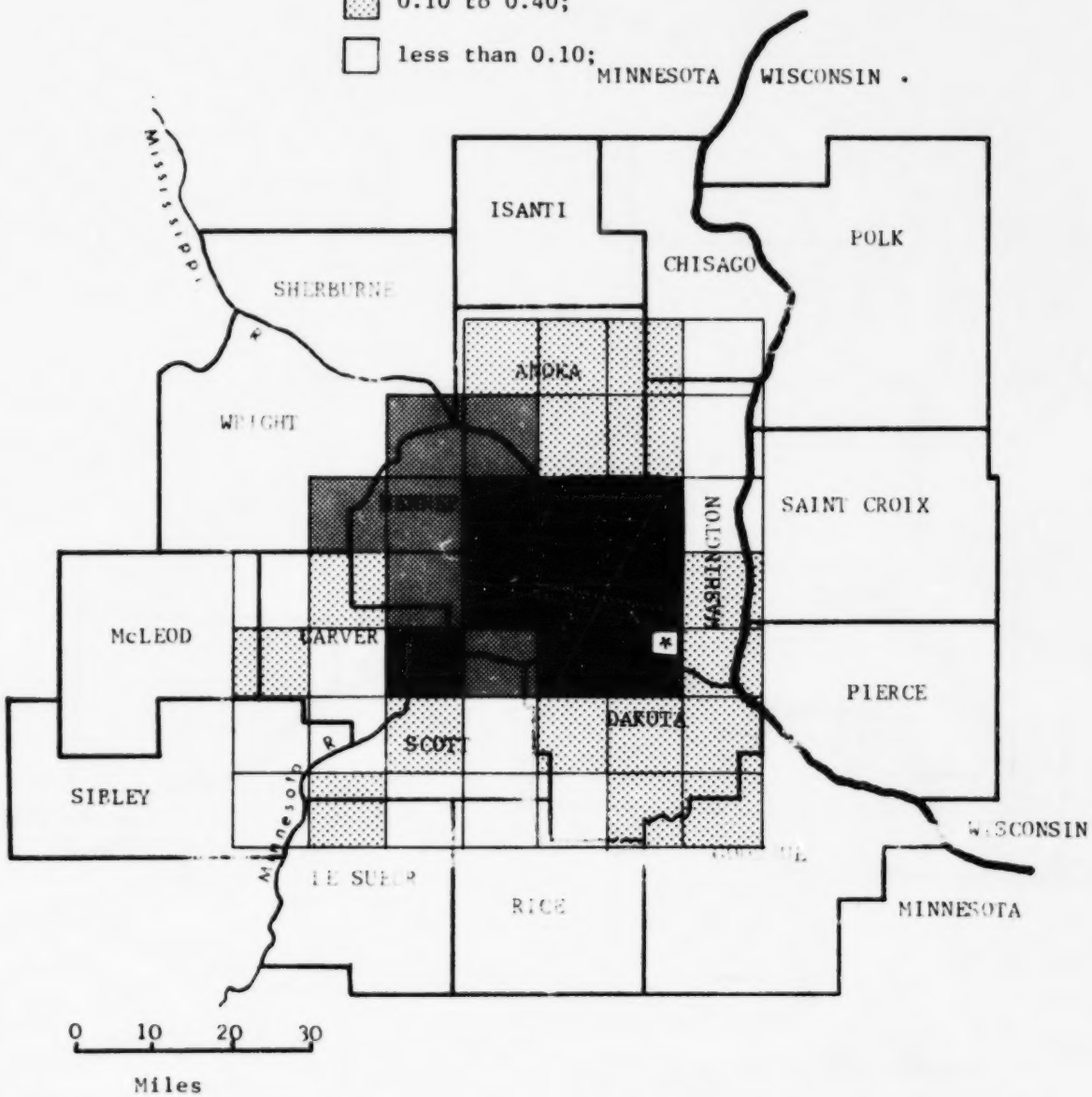
Figure 10:

CARBON MONOXIDE EMISSIONS DENSITY

Tons Per Square Mile Per Day

- more than 1.0;
- 0.40 to 1.0;
- 0.10 to 0.40;
- less than 0.10;

* indicates that more than 50% of the emissions in the grid are due to point sources;



the area is fuel burning by power plants and industry. However, residential space heating also contributes to the problem. Industrial point sources are the most important sources of particulate emissions. Automobiles and other motor vehicles are almost solely responsible for widespread emissions of carbon monoxide.

AIR QUALITY ANALYSIS

A study of air quality levels known or estimated to occur is useful in determining the area affected by the pollution sources and thus subject to inclusion in the air quality control region. Such analysis can be based directly on air quality sampling data in those instances where the sampling program covers a large enough area and has been in existence long enough to provide reliable patterns of air quality throughout the region under study. Measured air quality data can be supplemented by estimated air quality data, derived from a theoretical diffusion model using information on the location and quantity of pollutant emissions and on meteorological conditions.

Measured Air Quality Data

Measured air quality data for the Minneapolis-St. Paul area is available from more than 90 locations. Dustfall and sulfation rate have been measured at most of the stations. However, only those stations located within the Cities of Minneapolis and St. Paul have recorded measurements for more than six months. About 50 stations are located outside of the two cities, distributed throughout a seven county area including Ramsey, Hennepin, Anoka, Washington, Dakota, Carver, and Scott. The measured air quality results are displayed in figures 11 and 12.

Figure 11:

MEASURED DUSTFALL

Tons Per Square Mile Per Month

more than 20;

15 to 20;

less than 15;

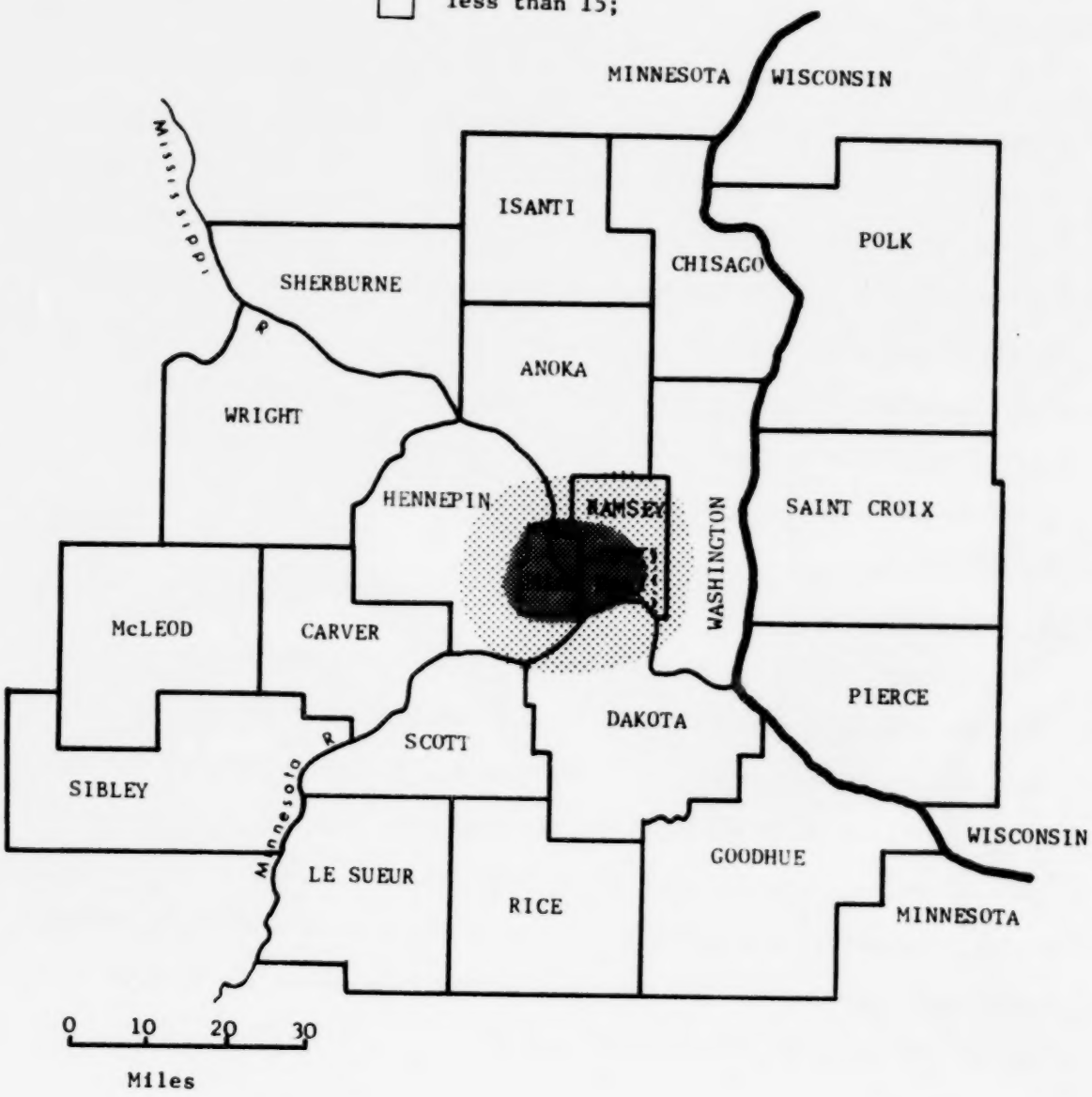
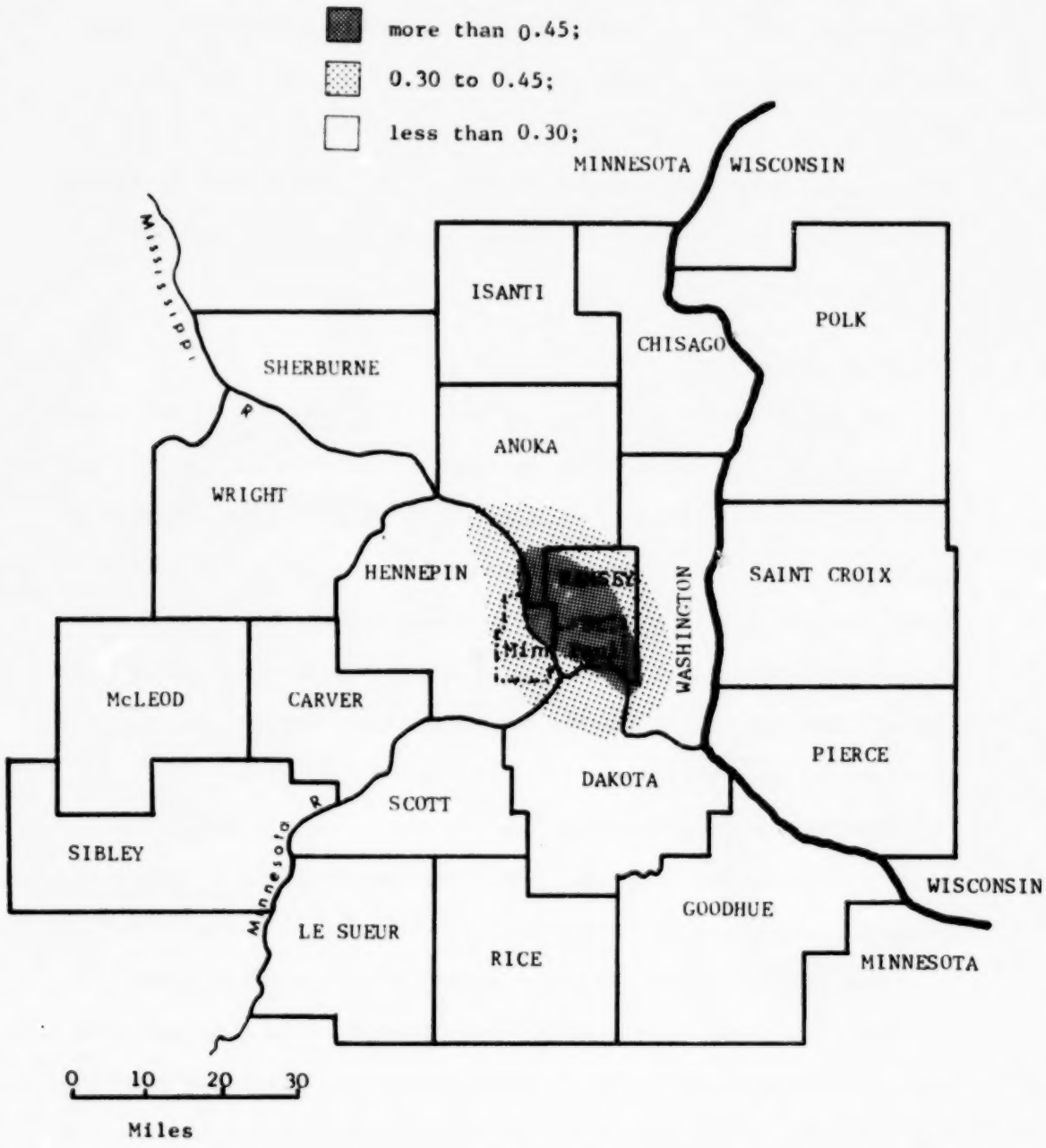


Figure 12:

MEASURED SULFATION RATE

Milligrams SO_3 Per 100 Square

Centimeters Per Day



Measured dustfall concentrations are highest in the urban centers of St. Paul and Minneapolis. Intermediate concentrations which are somewhat above background values in outlying areas extend into portions of Hennepin, Ramsey, Dakota, Washington, and Anoka Counties. Sulfation rate measurements are highest in the urban center. The peak values form a pattern which is somewhat elongated along the valley of the Mississippi River. Intermediate concentrations, still above background levels, extend into portions of Ramsey, Hennepin, Anoka, Washington, and Dakota Counties.

Estimated Air Quality

The diffusion model was applied for carbon monoxide, sulfur oxides, and particulates for three different time periods--summer, winter, and annual. For each pollutant, the time period which yielded the most extensive air pollution problem is the appropriate period to consider. Carbon monoxide air pollution is most widespread in the summer period, whereas particulates and sulfur oxides are most widespread in the winter period. The theoretical results for these three combinations of pollutant and time period are shown in figures 13, 14, and 15.

The theoretical particulate concentrations are highest in the urban center and extend in decreasing quantities into portions of Ramsey, Hennepin, Dakota, and Anoka Counties. Scott and Carver seem virtually unaffected by particulate pollution generated in the urban center.

The theoretical sulfur oxides concentrations form a pattern with peaks which correspond to the highest emission density areas shown in Figure 8. One of these peaks is associated with a power plant located

Figure 13:

THEORETICAL PARTICULATE CONCENTRATIONS
(WINTER AVERAGE)

Micrograms Per Cubic Meter

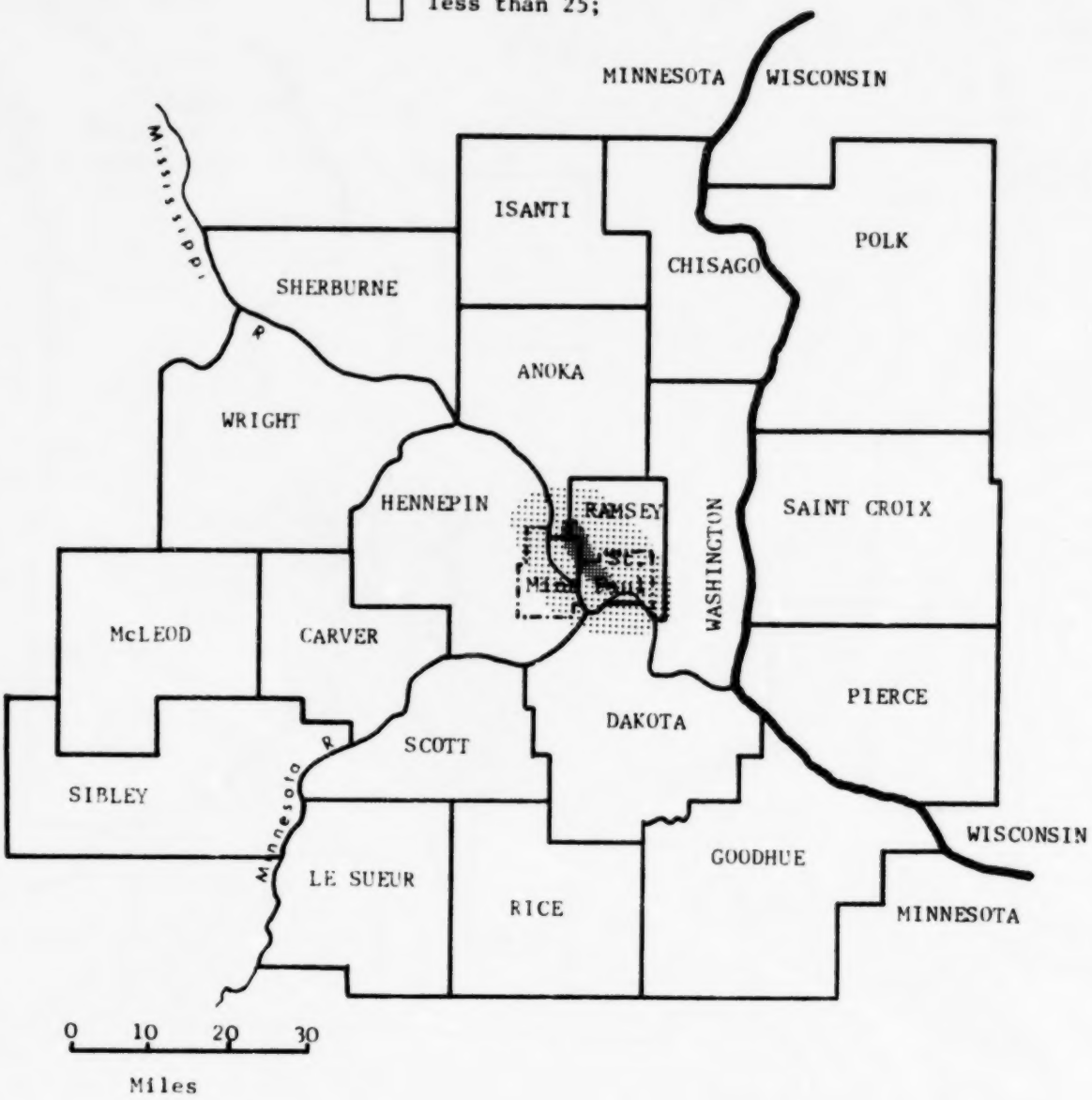


Figure 14:

THEORETICAL SULFUR OXIDES CONCENTRATIONS
(WINTER AVERAGE)

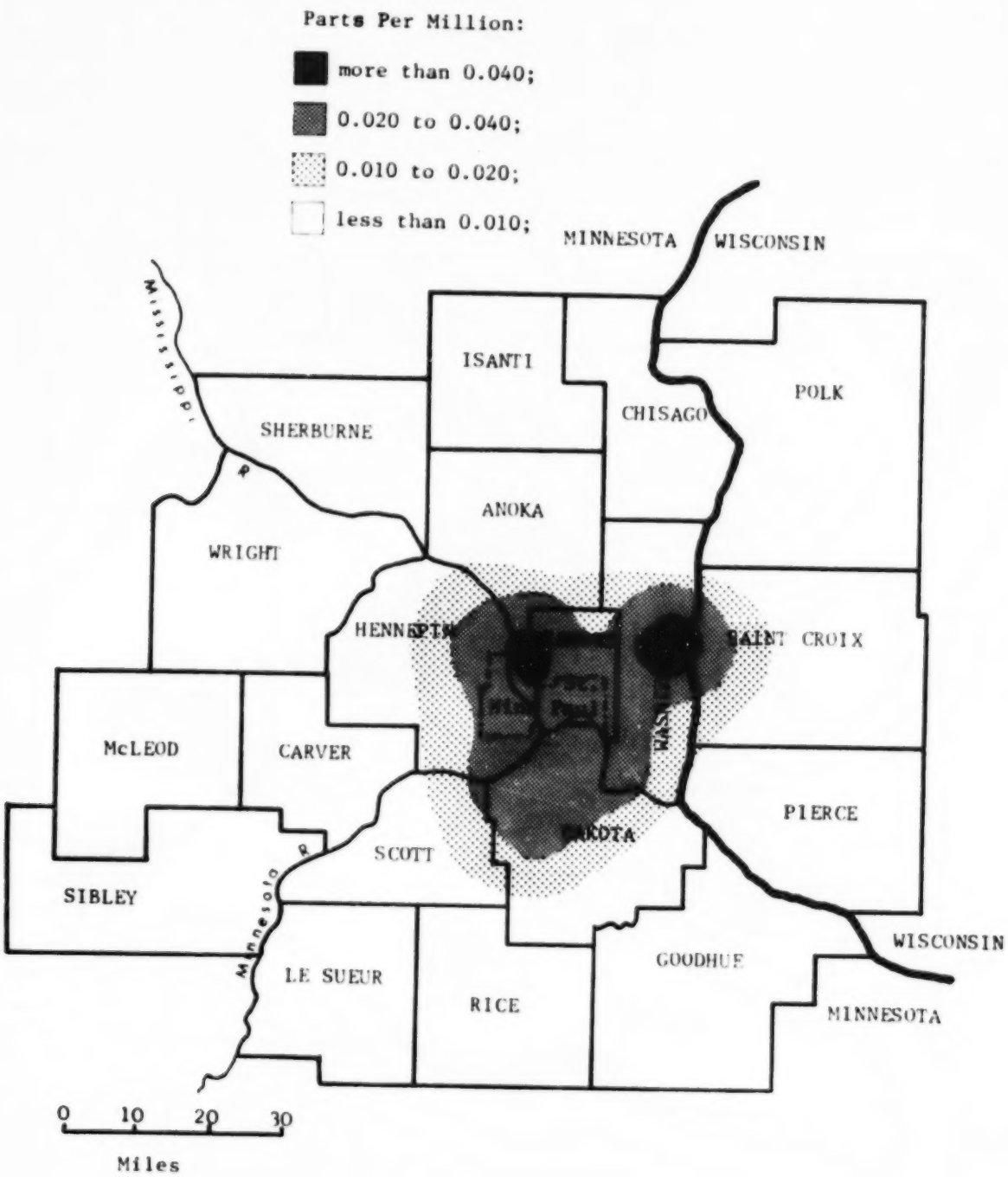
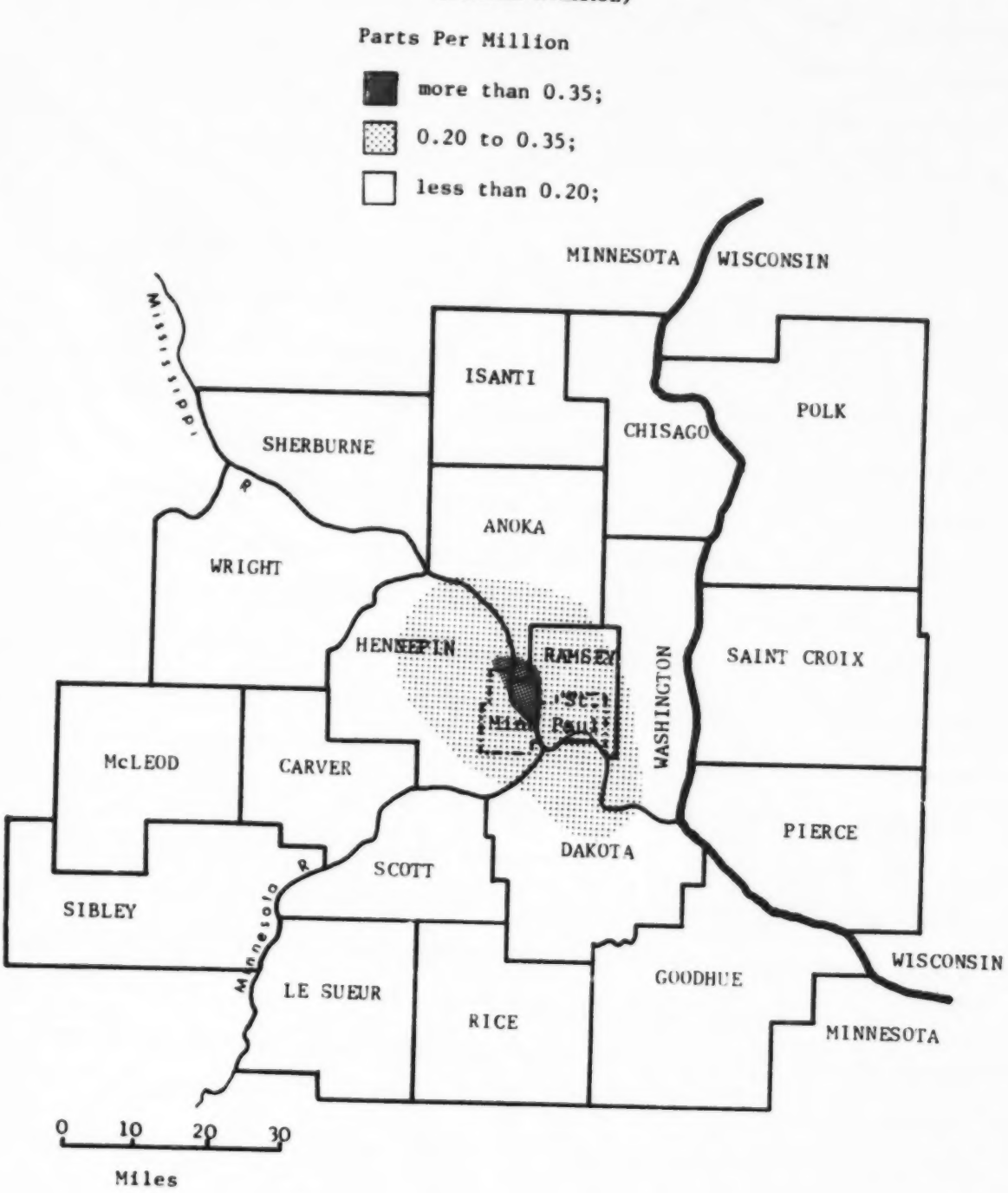


Figure 15:

THEORETICAL CARBON MONOXIDE CONCENTRATIONS
(SUMMER AVERAGE)



in Washington County along the St. Croix River. As a result, theoretical concentrations of sulfur oxides which are significantly greater than background levels extend into Saint Croix County in Wisconsin. With this exception, the effect of sulfur oxides emissions appears to be limited to areas in Ramsey, Washington, Dakota, and Hennepin Counties.

Due to the lack of sufficient measured data on carbon monoxide concentrations in the ambient air, the theoretical estimates cannot be checked in detail. However, there is some evidence that the estimates are lower than actual concentrations. For example, "in traffic" studies in Minneapolis have measured average carbon monoxide concentrations of about 35 parts per million in center city traffic. A two-day survey in the Nicollet Mall of Minneapolis revealed average concentrations of about 15 parts per million. These measured values are on the order of 50 to 100 times larger than the theoretical concentrations, a discrepancy which is only partially explained by the fact that the "in traffic" studies were conducted on the roadways, and that the Nicollet Mall study was a short term study. It seems realistic to conclude that the theoretical carbon monoxide concentrations do not accurately represent actual concentrations. On the other hand, the theoretical concentrations do offer a guide to the extent of carbon monoxide pollution when background level iso-intensity contours are considered in relation to peak value contours. From this point of view, Figure 15 seems to indicate that carbon monoxide pollution encompasses parts of Anoka, Hennepin, Ramsey, Dakota, and Washington Counties. Carver and Scott are affected only slightly.

SUMMARY

The emissions inventory and the air quality information are important indicators of how large a region must be in order to contain all of the major technical elements of the air pollution problem. From the above analysis, it appears that Ramsey, Hennepin, Anoka, Dakota, and Washington Counties should be included in the Minneapolis-St. Paul Region. Surrounding counties appear not to be closely linked to the air pollution problem at this time. In particular, Scott and Carver Counties have only marginal impact upon the pattern of emissions, and are subjected to only marginal concentrations of pollution from the urban center. Saint Croix County in Wisconsin is affected to some degree by sulfur oxides emissions from the power plant in Washington County. Otherwise, Saint Croix County is not linked to the air pollution problem of the Minneapolis-St. Paul area.

THE PROPOSED REGION

PROPOSAL

Subject to the scheduled consultation, the Secretary, Department of Health, Education, and Welfare, proposed to designate an air quality control region for the Minneapolis-St. Paul area, consisting of the territory encompassed by the following jurisdictions:

In the State of Minnesota:

Anoka County

Carver County

Dakota County

Hennepin County

Ramsey County

Scott County

Washington County

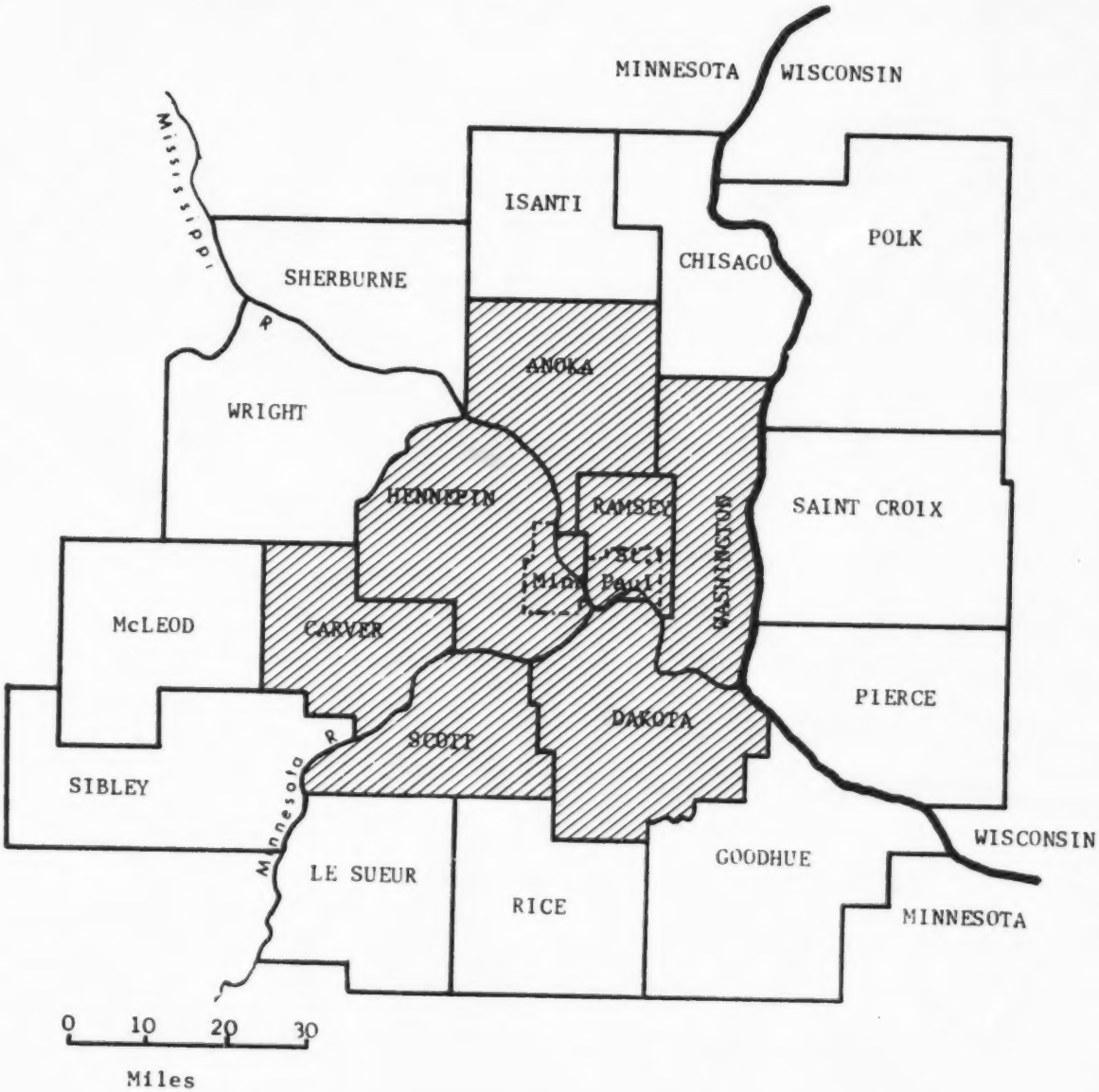
The boundaries of the proposed Region are illustrated in Figure 16.

DISCUSSION OF THE PROPOSAL

To be successful, an air quality control region should meet three basic objectives, as discussed in the section entitled "The Size of a Region", page 6. First, a region should be self-contained with respect to air pollution sources and receptors. Second, a region should be designed to meet not only present conditions but also future conditions. Third, region boundaries should foster unified and cooperative governmental administration of the air resource throughout the region. The proposed boundaries of the Minneapolis-St. Paul Air Quality Control Region satisfy these three objectives.

Figure 16:

PROPOSED REGION



From a technical point of view, the core of the proposed Region consists of the five counties presently included in the Standard Metropolitan Statistical Area; Ramsey, Hennepin, Anoka, Washington, and Dakota. These counties contain most of the air pollution emission sources and most of the receptor population. These counties contain the most highly urbanized areas, and are closely linked to the Twin Cities by cultural and economic ties.

At the present time, Scott and Carver Counties appear to be only slightly affected by air pollution from the urban area. These two counties contain only a few sources, and a small portion of the receptor population. In this sense, they are on the periphery of the core area. However, in order to satisfy the second and third objectives mentioned above, these two counties should be included in the Air Quality Control Region. Portions of Scott County are only ten miles from Minneapolis. Both Scott and Carver are expected to grow rapidly during the next sixteen years, perhaps enough to double their present population. This growth will be linked economically and socially to the urban center. In anticipation of this growth, Scott and Carver have already been linked to the urban area through the activities of the Metropolitan Council. In addition, the Minnesota Pollution Control Agency has linked Scott and Carver to the urban center in its proposed air quality and emission standards. For these reasons, it seems appropriate to include Scott and Carver in the proposed Region.

Counties surrounding the seven county metropolitan area are rural in nature and are expected to grow at a slow rate during the next ten to twenty years. They have no existing governmental ties to the

metropolitan area, and except for Saint Croix County they are virtually unaffected by air pollution from the urban center. Thus, except for Saint Croix County, it seems clear that surrounding counties should not be included in the proposed Region. In addition, it appears advisable not to include Saint Croix County in the proposed Region. The inclusion of Saint Croix County would add many complications to standard setting and enforcement associated with an interstate region. Aside from the emissions of the power plant in Washington County along the St. Croix River, Saint Croix County is virtually unaffected by air pollution generated in the metropolitan area. The power plant would fall within the jurisdiction of the Region even without the inclusion of Saint Croix County. The air quality of Saint Croix County is more likely to be protected expeditiously if the complications associated with interstate regions are avoided.

The proposed Region seems to satisfy the three objectives of air quality control region boundaries. This proposal represents a starting point for discussion in the consultation with appropriate State and local officials, which will be held before the Minneapolis-St. Paul Region is finally designated.